



Delayed permanent water tested on farm

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- Fallowing the field ahead of the rice crop will improve soil moisture content and water saving, improving the chance of sowing and establishing the crop on rainfall moisture.
- On-farm demonstrations showed that rice is able withstand significant periods of moisture stress from establishment through to late tillering.
- Flushing irrigations were successfully managed in conjunction with rainfall to minimise water use.
- Yield results were variable in the 2008–09 season due to heat stress and subsequent cold at flowering.

The delayed permanent water system is where the rice crop is intermittently flushed and the application of permanent water is delayed until about a week before panicle initiation. Delayed permanent water aims to provide an opportunity to improve the water productivity of rice (t/ML), reduce water use (ML/ha) and improve gross margins per megalitre (\$/ML).

In a delayed permanent water system flushing of the crop up until panicle initiation is only carried out to augment rainfall and moisture remaining from previous crop or fallow. Although similar research has been carried out in the past, the proposed system stresses the rice more between flushes. Management of the crop is a balance between saving water and stressing the crop and flushing to promote rice growth. It is crucial to apply permanent water to the crop just before panicle initiation, to build water levels to protect the crop from cold damage at the microspore development stage and provide adequate moisture for the grain production phase.

Given the drought and reduced water availability, a few growers successfully trialled the technique of delaying the application of permanent water to rice to save water and improve water productivity. In the 2007–08 rice season a local grower was able to achieve water productivity close to 1.2 t/ML by delaying the application of permanent water, far exceeding expectations. This created a lot of interest throughout the region.

In the 2008–09 rice season three growers in the MIA and CIA participated in demonstrations of the delayed permanent water system. Water use, rainfall, inputs, biomass and yield were measured to evaluate any water savings and compare water productivity (tonnes per megalitre) with normal early permanent water practice.

Trials conducted in the early 2000s by NSW DPI researcher John Thompson timed flushes on a set 50–60 mm ET interval and saved 10–15% water. In 2008–09 the farmers only flushed to supplement rainfall to keep the crop alive. The rice was therefore stressed more between flushes than in past trials. By stressing

the rice, crop growth may be reduced and yields may also be reduced by 10–20%, compared with an early permanent water crop. However with potentially lower inputs and water savings of up to 20%, the gross margin per megalitre and tonnes per megalitre for a delayed permanent water crop may be higher than for an ET interval flushed or early permanent water crop.

A replicated experiment at Yanco in 2008–09 looked at the delayed permanent water rice system with the aim of quantifying water use and rice grain yield over a range of irrigation frequency treatments, with all treatments having permanent water from panicle initiation onwards, through the reproductive period. The results of this experiment are reported in this edition of the *Farmers' Newsletter* (pp 4–7) and the previous edition (No. 180).

On-farm demonstration results

The 2008–09 rice harvest started mid/late March and yields were variable, and in many cases disappointing due to the record heatwave conditions of late January/early February. It appears that crops sown early may have been affected by high temperatures during flowering which caused sterility (with rice susceptible to high temperature damage at flowering when temperatures reach 38°C). This was particularly the case with crops flowering around 7 February in the hot windy conditions. Following on from this hot spell was a cold spell with a number of night time temperatures around 13 and 14°C. This may have caused some additional sterility at flowering.

The heatwave and cold nights affected the results of the three delayed permanent water demonstrations in 2008–09. Although the results compare well with the overall rice industry average of 8.3 t/ha and water productivity of 0.56 t/ML, only one of the crops had a higher water productivity compared to the average (Table 1). The yield and water productivity of each of the three crops were:

- 8.0 t/ha and 0.57 t/ML for the Yanco crop where yield was greatly affected by the heatwave and cold nights at flowering



- 9.0 t/ha and 0.67 t/ML for the Griffith crop
- 8.75 t/ha and 0.53 t/ML for the Coleambally crop which had high water use and a later sowing date than the other 2 crops (Table 1).

These water productivities were also less than the *RiceCheck* water productivity targets (0.8 t/ML for the medium grain variety Amaroo in the MIA and 0.75 t/ML for Amaroo in the CIA), due to the lower yields resulting from the record heatwave conditions of late January/early February followed by cold nights at flowering causing high levels of sterility.

Experience from the 2008–09 season showed rice is able withstand periods of significant moisture stress from establishment to late tillering allowing flexibility with weed control, nitrogen application and flushes.

All crop details for the three demonstration sites are in Table 1.

Questions unanswered

There is still a lot of uncertainty with the management of the delayed permanent water system.

Nitrogen management

It is not known at which flushes and growth stages to apply nitrogen as intermittent flushing will mean larger losses of applied nitrogen. When the soil dries after flushing, nitrogen is available to rice in the ammonium or nitrate form. However during flushes



Figure 1. Barry Kirkup showcases his delayed permanent water rice crop at the 2009 rice field day at Yanco (photo: John Lacy).

when the rice is re-ponded and the soil is anaerobic the nitrate is converted to nitrous oxide which is lost as a gas.

Since permanent water is applied shortly before panicle initiation the rice is more stunted than with early permanent water crops so there is a need to recalibrate the NIR tissue test and provide updated recommendations for nitrogen uptake and topdressed nitrogen.

Table 1. 2008–09 delayed permanent water demonstration details

	Yanco	Griffith	Coleambally
Variety	Langi	Reiziq	Amaroo
Sowing date & method	3 October 2008 Sod sown into grader board fallow	8 October 2008 drill sown	20 October 2008 sod sown into pasture
Plant population	216 plants/m ²	160 plants/m ²	–
Crop management	Sept 08 0.75L/ha Roundup®	no flushing	22 Oct 1st flush (1.0 ML/ha)
	28 Oct 1st flush (2.1 ML/ha)	Stam®, Ordram®, Saturn® around banks	24–26 Oct Roundup 1 L/ha
	1 Dec 0.5L/ha Aura + 1L/ha Supercharge	7 Dec 150 kg/ha urea spread	4 Nov 2nd flush (0.75 ML/ha)
	9 Dec 0.5L/ha Lorsban® for locusts, 250 kg/ha urea applied just ahead of permanent water	8 Dec permanent water applied early because of locusts	17 Nov 3rd flush (0.75 ML/ha) 90 kg/ha urea spread (only 2 mm rain)
	10 Dec permanent water was applied earlier than planned because of locusts	Early Jan 75 kg/ha urea topdressed	4 Dec 4th flush (0.75 ML/ha) Barnstorm 1.1 L/ha, Magister® 120 mL/ha, Hasten® 1 L/ha
	23 Dec 1L/ha Barnstorm® + 1L/ha Uptake®		18 Dec permanent water started
PI date	16 January 2009 Nitrogen uptake was 91 kg N/ha. Crop was topdressed on 21 January at 125 kg/ha urea.	15 January 2009 Nitrogen uptake was 122 kg N/ha for north crop (sampling after topdressing so N uptake is inflated) and 106 kg N/ha for south crop	14 January 2009
Harvest	29 March	30 March	9 May
Rainfall (Oct to end Mar)	112 mm	134 mm	88 mm
Irrigation water use	12.5 ML/ha	12.0 ML/ha	16.5 ML/ha
Yield	8.0 t/ha	9.0 t/ha	8.75 t/ha
Water productivity	0.57 t/ML	0.67 t/ML	0.53 t/ML



Phosphorus

Phosphorus application rates may need to be increased because we expect phosphorus will be less available under aerobic conditions than under early permanent water systems. When ponded water is applied to a rice paddock chemical processes in the soil allow higher levels of phosphorus to become available for the crop. Under a delayed permanent water system there may be the need for additional phosphorus.

Grass weeds

Grass weed control is a significant challenge and will be much more difficult with delayed permanent water than for the early permanent water system. Rainfall and flushing are ideal for barnyard and silvertop grass germinations and growth and most herbicides rely on early follow up permanent water to assist weed control. Since permanent water is not being applied early there is more reliance on herbicides for weed control. Weed control research in this system by Malcolm Taylor, Agropraisals, started in 2008–09.

Delayed crop development

Lastly rice development is usually delayed when rice is moisture stressed. Delayed permanent water slows down crop development, and the more the stress between flushes the longer the delay subsequently the delay could mean the crop is irrigated for a longer period thus delaying harvest and reducing water savings.

Continuing interest in the system

After one year's evaluation by three growers, the delayed permanent water system shows promise for reducing water use and improving water productivity. The replicated experiment at Yanco showed improved water productivity with delayed permanent water. The system is a potential tool for improving

water use efficiency by using rainfall through following rice fields in autumn to improve the chance of sowing and establishing rice on rainfall moisture. If there is no rainfall crops can be flushed for establishment. Thus, good irrigating and draining layouts are needed.

It is important to understand that the delayed permanent water rice system will not suit everyone's rice growing system, eg non lasered layouts with no drainage and/or sodic soils.

The ability of rice to handle periods of moisture stress and be able to compensate when delayed permanent water is applied is a potential management tool for a changing climate.

As with any new technology a few more seasons' evaluation of the system is needed to show the strengths and weaknesses of the system and whether delayed permanent water has better water productivity than early permanent water. Although the results of 2008–09 were mixed two of the farmers are keen to continue and another farmer has already contacted the authors to be involved in the 2009–10 season.

Any farmers interested in the system are encouraged to contact their District Agronomist. 

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Further information

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Figure 2. An establishing delayed permanent water crop at Yanco (photo: John Lacy)